of data in the buffer memory.

The first error detecting means pairs up with the first syndrome calculating means and performs error detection concurrently therewith.

The second syndrome calculating means performs syndrome calculation of demodulated codes without the buffer memory.

The second error detecting means pairs up with the second syndrome calculating means, and performs error detection concurrently therewith.

The storing means stores the right portions of mid-term results of calculations of the first error detecting means and the second error detecting means in descending order of code words and sectors.

The buffer memory parallel transfer means transfers data transmitted from upstream to the second syndrome calculating means and to the second error detecting means in parallel with storage of the data in the buffer memory until the second syndrome calculating means detects an error-containing code.

The error-detecting-means switch means provides the storing means with the mid-term results of the calculation by the second error detecting means of code words until the error-containing code is detected.

The error correcting means performs error correction after one of the first error detecting means and the second error detecting means detects an error-containing code word, so as to perform error correction of data in the buffer memory directly or indirectly.

The parallel transfer means transfers data stored in the buffer memory, starting at a code word which is not stored in the storing means to the first syndrome calculating means and to the first error detecting means,

on and after the second-time error correction in the same direction, before the first syndrome calculating means detects an error-containing code.

The second-time onward detecting-processed data use means performs error detection of the subsequent code words by using the mid-term results stored in the storing means, on and after the second-time error detection in the same direction done by the second error detecting means.

While the results of previous calculation are used in ECC units in and after the second-time error correction in the aspect 28, it is done in predetermined data units such as one sector at a time or one sector group at a time in the aspect 29. Therefore, the aspect 29 has the same advantages as those which the aspects 24-27 provide for the aspects 20-23.

The aspect 30 is a combination of the aspects 20-23 or the aspects 24-27 and the aspect 28 or 29. Therefore, demodulated data are subjected to error correction before being stored in the buffer memory, and the data stored in the buffer memory are subjected to error correction in pipeline processing. Furthermore, the mid-term results in the previous error calculation are used either one ECC, one sector, or one sector group at a time.

Therefore, the syndrome calculating means or the error calculating means, which directly executes syndrome calculation of demodulated data, executes syndrome calculation of the data in the buffer memory after all of the demodulated predetermined data are stored in the buffer memory. This further increases the speed of error calculation, and is useful to execute a high-speed processing of data stored in media that have been

under poor storage conditions for a long time period.

In the aspects 31-50, there are two buffer memories, and when data in one buffer memory are subjected to error correction, a predetermined amount of data such as in subsequent sectors or in ECC block units are

5   written to the other buffer memory. While the error-corrected data are read from one buffer memory in order to be transmitted downstream, subsequent data in the other buffer memory are already subjected to error correction. For this, the accessed buffer memory switch means directs the buffer memory to be accessed to the bus control means and the system

10   control means. As a result, the effects of high-speed error correction with the mid-term results are exerted more effectively.

When it is difficult to provide error correction for the data read and demodulated at normal speed, in a device where reading is done again by varying the speed, the data in the same sector as the sector whose data are

15   read again are stored in place of or after the data of the subsequent sector, and in the former case, the data are subjected to error correction later, and in the latter case, these data are replaced after error correction.

The alternating switch between two buffer memories and one-sector shifting of data in reading them again are not hard techniques in terms of

20   programs, circuits, or hardware, so that their description will be omitted.


BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the data format for one sector of a DVD.

Figure 2 shows the data format for one block including ECCs of a

25   DVD.